



Bureau of Energy Efficiency



सत्यमेव जयते  
Government of India  
Ministry of Power



# ANGAN

## Augmenting Nature by Green Affordable New-habitat

A Courtyard for Revolutionary Change in Building Energy Efficiency

An International Conference on Building Energy Efficiency

9<sup>th</sup>-11<sup>th</sup> September, 2019 | Hotel The LaLIT, New Delhi





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THIS PRESENTATION WAS SHARED BY

**Mr. Pramod Adlakha**

Managing Director, Adlakha Associates Pvt. Ltd. & Adlakha  
Affordable Homes

FOR THE SESSION:

*“Emerging Construction Practices & Technologies”*

DURING ANGAN 2019

Knowledge Partner



Event Partner



# International Conference and Exhibition on Building Energy Efficiency

## Augmenting Nature by Green Affordable New-Habitat (ANGAN)

### Emerging Energy-Efficient Intermediate Construction Technologies

PRAMOD ADLAKHA

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- Adlakha Associates Pvt. Ltd
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**10 September 2019  
New Delhi, India**

- Cost effectiveness
- Compatible to Architecture
- Simple to understand
- Ease of construction
- Study & durable
- Energy conscious
- Security, safety
- Ease of maintenance
- Optimisation of material strength
- Conservation of natural resources
- Conservation of cement & steel
- Conservation of energy
- Employment generation, skill development
- Quality off-site & on-site
- Availability

## **ISSUES**

### **(Brick and Mortar + Conventional In-Situ-Technology)**

- Quality
- Time
- Labour intensive
- Supervision
- Non-skill agriculture labour

## **TRANSFORMING INDIA**

- From Brick and mortar to block w/o mortar
- From CIT to on-site Prefabrication
- Transition from manual to mechanisation  
(Quality & productivity)

## *Western Criteria of Technology Acceptance*

- Focus on only thermal insulation of cold weather abroad.
- Focus on housing for one generation

## *Indian Criteria of technology acceptance*

- Cost Affordability
- Life styles & comforts are not equivalent to western countries
- Focus on life of building for generations
- In the name of Technology Innovation **we have forgotten our own** “Make in India” and “Made for India” Technologies in the Building Industry.
- TAC Approvals and BIS Codes, CPWD are oriented towards specifications and not the “cost or performance”
- Western Technologies are based on principles of Heating & Cooling, with higher comfort levels than required for EWS and LIG in India

CONCEPT OF APPROPRIATE  
TECHNOLOGIES FOR AFFORDABLE  
HOUSING

**LEVEL of TECHNOLOGIES**

• **Low & traditional**

• **Intermediate**

• **Hi-Tech**

- Fly ash bricks (Fal-G)
- Perforated mechanised clay bricks
- Modular bricks
- Compressed stabilised soil bricks (CEB)
- Hollow concrete blocks (CMU)
- Reinforced HCB
- AAC Blocks
- CLC Blocks
- Stone block masonry
- Interlocking blocks
- Light weight poly concrete panels
- Bonds :
  - Rat-trap bond
  - 190 mm stretcher bond
  - Zig-zag bond
  - Cavity wall
  - Confined masonry

- Filler slab, RBC
- Hollow 'Kulars' slab
- Precast RB Panel
- Precast Brick Arch. Panel
- Precast funicular shell
- Precast channel
- Precast RC planks and joists
- Thin RC Ribbed slab
- L-panels
- Precast Ferro-crete panels
- Monolithic shear wall
- MCR tiles
- Vernacular – Vaults, corbel, pyramid, arched, semi arched

- Under reamed piles
- Arched foundations
- Strip floating foundations
- Ferro-cement Technology
  - Steps
  - Boundary wall
  - Water tank
  - Sunshade
  - Kitchen working platform
  - Window shutters
  - Concrete D/W frames

- Precast Large Concrete Panel System (PLCP)
- RCC Shear wall System
- Precast Glass Fibre Reinforced Gypsum System (GFRG) also called Rapid Panels
- Light Gauge Steel Framed (LGSF)
- MODUCAST, Precast Concrete Box System
- EPS Core Precast Wall Panels
- Waffle Crete System
- Pre-stressed Hollow Core Panels
- Expanded Steel mesh panel system
- Tunnel Form Technology
- Speed floor Technology
- Reinforced EPS core panel system
- LGSFS-ICP Technology
- Prefabricated fibre reinforced sandwich panels
- Rising EPS (beads) cement panels
- Concrewall system
- 3S System
- Insulating concrete form blocks walling

## EWS HOUSING - YEAR 2006

### RAJIV GANDHI HOUSING, BAWANA - 3164 HOUSES



#### Roofing

Precast RC planks & joists roofing  
Precast ferrocement elements

#### Walling

Perforated mechanized modular bricks  
FAL-G modular bricks

#### Other Components

Single stack system of plumbing

## TECHNOLOGIES



# EWS HOUSING - YEAR 2008 BAWANA, DELHI -1184 HOUSES

## TECHNOLOGIES

- Modular perforated Brick Walls
- Precast RC Planks & Joists Slab
- Precast Ferrocement Elements



## **EWS HOUSING - YEAR 2006** **NARELA, DELHI - 1892 HOUSES**

### **TECHNOLOGIES**

- Modular perforated Brick Walls
- Precast RC Planks & Joists Slab
- Precast Ferrocement Elements



**EWS HOUSING - YEAR 2009**  
**NARELA (NEAR CETP), DELHI, 1652 HOUSES**



**TECHNOLOGIES**

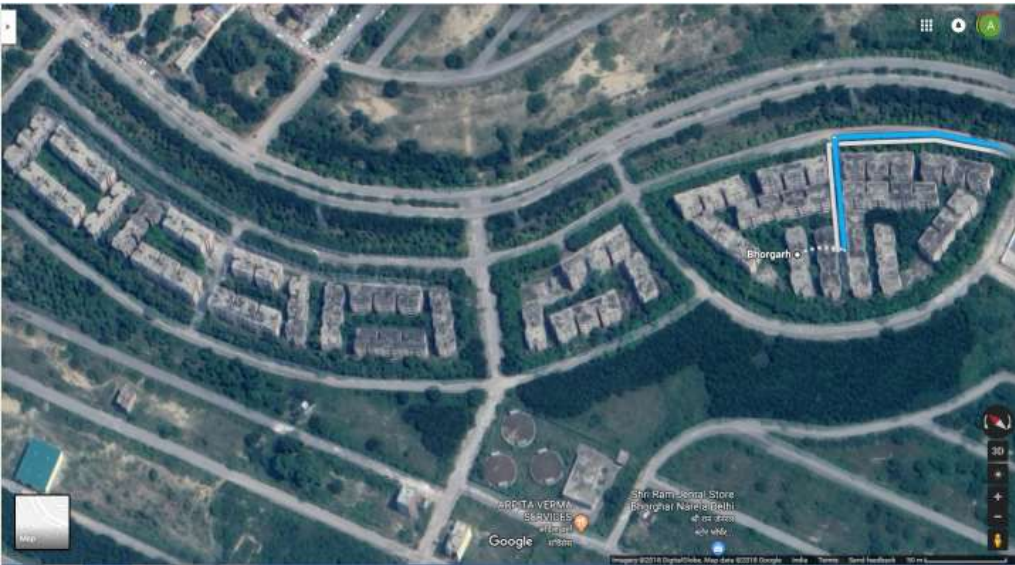
- Modular perforated Brick Walls
- Precast RC Planks & Joists



# HOUSING FOR URBAN POOR – YEAR 2011 BHORGARH, DELHI, 1272 HOUSES

## TECHNOLOGIES

- Modular perforated Brick Walls
- Precast RC Planks & Joists Slab
- Precast Ferrocement Elements



**EWS HOUSING - YEAR 2010**  
**BAPROLA, DELHI, 5568 HOUSES**



**TECHNOLOGIES**

- Modular perforated Brick Walls
- Precast RC Planks & Joists Slab
- Precast Ferrocement Elements

**EWS HOUSING - YEAR 2008**  
**BAWANA, DELHI – 896 HOUSES**



**TECHNOLOGIES**  
Monolithic technology



## **EWS HOUSING – YEAR 2016** **BAKARWALA, DELHI – 240 HOUSES**



### **TECHNOLOGIES**

- Mechanized bricks
- Flyash bricks
- Precast R.C. Planks and Joists Roof

# EWS HOUSING POOTHKHURD , DELHI - 10140 HOUSES

- TECHNOLOGIES**
- RC Planks & Joists Roof In framed structure
  - Flyash brick walls



# EWS HOUSING KALKAJI, DELHI - 3024 HOUSES

- TECHNOLOGIES**
- Waling - CLC Blocks

Google View



# EWS HOUSING FARIDABAD & PALWAL (ERA GROUP) - 578 HOUSES

## TECHNOLOGIES

- Modular perforated bricks
- Precast RC Planks & Joists Roof



Era Adel Divine, Era Divine Court, Era Redwood Residency



**EWS HOUSING**  
**SUSHANT GOLF CITY, LUCKNOW**  
**2750 HOUSES**

**TECHNOLOGY :- Monolithic RCC**





**EWS HOUSING - YEAR 2009**  
**GHOOGHA, DELHI – 3680 HOUSES**

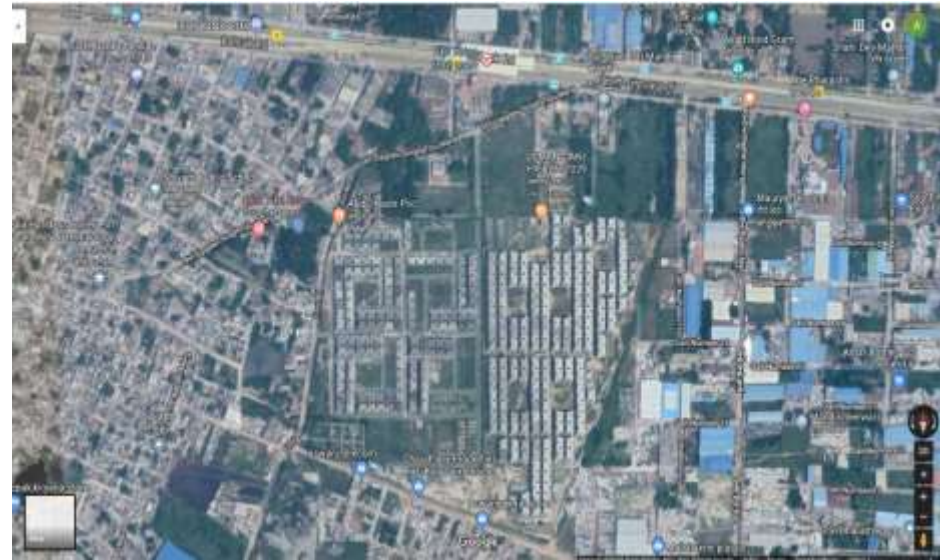
**TECHNOLOGY :- Monolithic RCC**



## **EWS HOUSING - ONGOING** **TIKRI KALA, DELHI – 4560 HOUSES**

### **TECHNOLOGIES**

- RC Planks & Joists Roof In framed structure
- Flyash brick walls



**EWS HOUSING - YEAR 2013**  
**BAWANA, DELHI – 704 HOUSES**



**TECHNOLOGY**  
Monolithic Technology



## **EWS HOUSING - YEAR 2010** **OMICRON, GREATER NOIDA, 1848 HOUSES**

### **TECHNOLOGIES**

- **Modular perforated Brick Walls**
- **Precast RC Planks & Joists Slab**
- **Precast Ferrocement Elements**

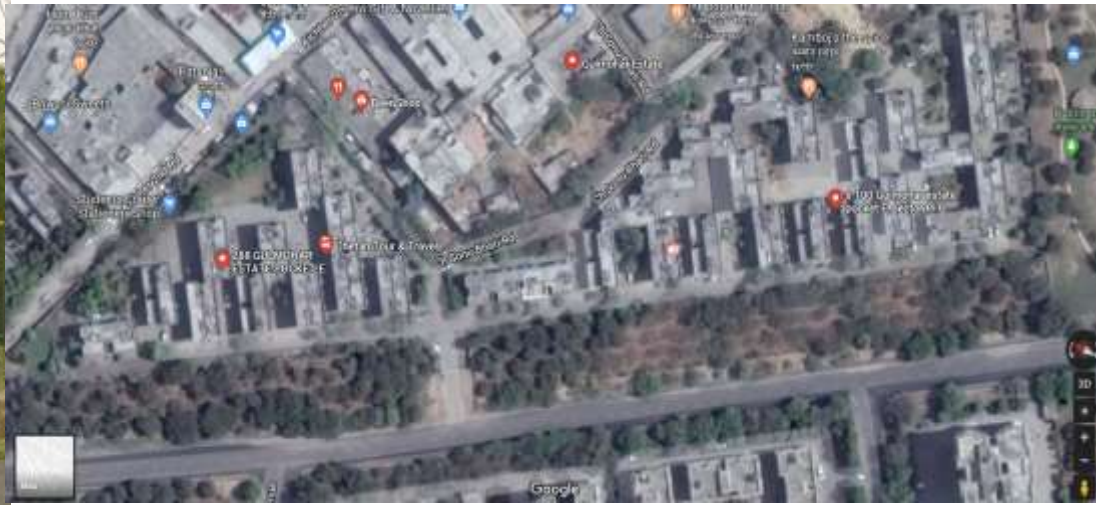


## LIG AFFORDABLE HOUSING GREATER NOIDA - 800 HOUSES



Cassia Estate

**TECHNOLOGIES**  
Walls :- Rat Trap Bond



Gulmohar Estate

**AFFORDABLE HOUSING - ONGOING**  
**DELHI POLICE HOUSING, DHEERPUR, DELHI - 5202**



**TECHNOLOGY**

Projects using  
Technology

Monolithic



# AFFORDABLE HOUSING - YEAR 2013 INNO GEOCITY, CHENNAI - 500 HOUSES



### TECHNOLOGIES

- Hydraform interlocking block walls
- Precast RC Planks & Joists Roof
- Stone masonry in foundation
- Precast Boundary wall

Underreamed piles

# Under reamed piles

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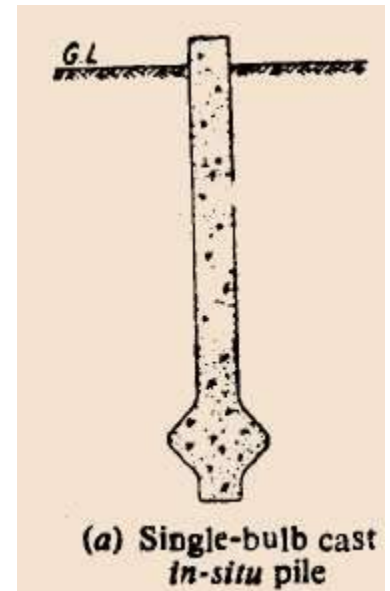
CASTING THROUGH TREME



AUGUR BORING IN PROGRESS



REINFORCEMENT CAGE IN PILE



Modular perforated  
mechanized Bricks

# Modular perforated mechanized Bricks

PRAMOD ADLAKHA  
ADLAKHA ASSOCIATES PVT. LTD



# Modular perforated mechanized Bricks

PRAMOD ADLAKHA  
ADLAKHA ASSOCIATES PVT. LTD





Project – EWS Housing at Bawana, Delhi



Modular fly-ash bricks

# dular fly-ash bricks

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ADLAKHA ASSOCIATES PVT. LTD



AAC block  
walls

# AAC block walls



**Project:  
EWS  
housing,  
for DDA, at  
Kalkaji**



Monolithic  
technology



Laying RCC strip foundation  
with dowel bars and wall  
reinforcement

Form work for Walls below plinth





External wall  
corner Formwork

Internal Walls &  
Ceiling Form work





Form work & Reinforcement for slab ready for casting along with the walls



Casting of Staircase Monolithically



Ceiling view after removal of Formwork

External wall formwork for  
First Floor structure





another view of external wall  
formwork for first floor structure



External wall Formwork for Second Floor

# Monolithic technology

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ADLAKHA ASSOCIATES PVT. LTD



Multistoreyed Building under Construction with Monolithic Technology in Mumbai



View of multi-storeyed building at Lucknow



Multistoreyed building in Progress

# Monolithic technology

PRAMOD ADLAKHA  
ADLAKHA ASSOCIATES PVT. LTD



View of completed building at Delhi

## RAJIV GANDHI HOUSING, BAWANA, 3164 HOUSES

- ✓ The FIRST Mass Housing scheme with **cost effective alternative technologies**.
- ✓ The **LARGEST Industrial Workers Housing** scheme in organized sector in Asia.
- ✓ The FIRST Housing Project to **use fly ash and fly ash products** on a large scale.
- ✓ The FIRST Mass housing Scheme with **mechanized perforated modular bricks**
- ✓ The FIRST Housing Scheme with **largest number of precast concrete** and ferrocement elements (approx. 4 lacs elements)
- ✓ The FIRST Low Cost housing **ISO-9001 Certified project**.

# RECOGNITION BY Ministry of Housing, Govt. of India & Govt. of NCDT, Delhi

PRAMOD ADLAKHA  
ADLAKHA ASSOCIATES PVT. LTD




FAÇADE IN PRAGATI MAIDAN “DELHI PAVILION” MADE TO REPRESENT “RAJIV GANDHI HOUSING PROJECT”




# RECOGNITION BY Ministry of Housing, Govt. of India & Govt. of NCDT, Delhi

PRAMOD ADLAKHA  
ADLAKHA ASSOCIATES PVT. LTD



## UTTAM GHAR - NYUNTAM DAR

A New Initiative of UPA Government



The Ministry of Housing and Urban Poverty Alleviation, Govt. of India is committed to promote & produce housing schemes through specific initiatives with special focus on the weaker sections of the society. And thus, fulfilling the Government's vision - "Affordable Housing for All"

**A vision to bring happiness to millions**

**The Government announces:**

- Introduction of 0% interest subsidy for EWS category for loans upto Rs. 1 Lac under the scheme for Housing the Urban Poor which would result in creation of additional housing stock of 3.70 lac houses for the EWS/LIG categories over the next 4 years.
- Public Sector Banks to lend for Home Loans at concessional rates @ 8.5% for loans upto Rs. 5 Lac and @ 9.25% for loans upto Rs. 20 lacs for the housing sector.
- Relaxation in External Commercial Borrowings (ECB) norms to facilitate access to funds for the development of integrated townships under the approval route of FDI.
- More liquidity in the system by reduction in rates of CRR and Repo and Reverse Repo which would facilitate increased lending by the banking sector towards housing.
- Refinance facility to NHB of Rs. 4,000 crore.

**Buniyad Buland Bharat Buland**

Ministry of Housing & Urban Poverty Alleviation  
Government of India  
Newman Bhawan, New Delhi - 110105.  
[www.mhupa.gov.in](http://www.mhupa.gov.in)



## Diya Apna Ghar Banaya Aatm Nirbhar Jeevan Hua Behtar



**Progress in appropriation of sum with houses and infrastructure:**

- Total Housing Units Approved for construction: 13,85,212
- Number of Ministry Clearance/A, B, C, D: 942
- Number of Projects Approved: 1189
- Total Project Cost Approved: Rs. 31,286 crore
- Total Central Share Approved: Rs. 17,389 crore

**Interest Subsidy Scheme for the Urban Poor who have loaned but not paid house:**

- A facility of 6 per cent interest will be given for loans of Rs. 1,20,000 to enable Economically Weaker Sections (EWS) and Low Income Group (LIG) households to all affordable housing loans by purchase of house / construction of new house (even during the 11<sup>th</sup> Plan).
- Min 50% of the housing cost will be assumed as primary requirement. There would be no collateral security. 10% cap on guarantee for loans upto Rs. 11 lakh.
- No levy of employment charges would be levied.
- The loan repayment period would be 10-20 years.
- Sanctionary instrument may change based on budgeting.
- Preference (subject to identification being EWS / LIG) would be given to Scheduled Caste, Schedule Tribe, Minorities, Persons with disabilities and women beneficiaries in accordance with their proportion in the total population of the urban agglomerations during the 11<sup>th</sup> plan.

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World Habitat Day  
1<sup>st</sup> October, 2012

## Building Habitats Changing Lives

**Journey of inclusive urbanization:**

- Launched Jawahar Nalwa National Urban Renewal Mission (JNNURM), Basic Services to the Urban Poor (BSUP) & Integrated Housing and Slum Development Programme (IHSUDP) in December 2003.
- Projects worth ₹ 43,812 crore approved for the construction of 1.37 million dwelling units.
- Announced National Urban Housing and Habitat Policy in 2007, with the goal of Affordable Housing for all.
- Launched Right to Live Mission with the focus on legal empowerment by giving property rights to slum dwellers.
- The Street Vendors (Protection of Livelihood & Regulation of Street Vending) Bill, 2012 introduced in Parliament.
- National Urban Livelihood Mission announced by Hon'ble President in Parliament.
- Credit Risk Guarantee scheme started for guaranteeing credit to MSMEs to tune ₹ 5 lakh.



Ministry of Housing & Urban Poverty Alleviation  
Government of India  
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## A significant step forward to make 10 Lakh Affordable Houses

(Central Government Support of Rs.5000 crores)

**New Announcing New Affordable Housing in Partnership:**

- A New Scheme is conceived to build 10 Lakh affordable houses.
- This Scheme will increase the stock of houses ranging from 200 sq.ft. to 1200 sq.ft.
- Construction and development is envisaged in PPP mode.
- Real estate developers have an opportunity to take up projects.
- An initiative to meet the urban housing shortage estimated at 24.7 million.
- Central Government will share costs on external civic infrastructures and connectivity for such projects.
- Home loans at reduced interest @ 8% to 9.5% for loans upto Rs. 8 lakhs, and @ 9.25% for loans upto Rs. 20 lakhs can now be availed by the masses.
- A minimum 25% houses of 300 sq.ft. will be compulsory for EWS & lower sections and the urban poor.

**Achievements so far under BSUP:**

- Total Central funds released to States/UTs under the Scheme - Rs. 1886.83 Crores.
- Physical cumulative progress under different components of BSUP:
  - Urban Self Employment Programme (USEP)
    - Number of people assisted to set up individual micro enterprises: 50,459
  - Number of women assisted to set up micro enterprises: 215536
  - Total number of urban poor assisted to set up micro enterprises: 416
- Number of people given skill development training: 1385716
- Number of Youth & Credit Societies formed: 280725

**Progress in appropriation of sum with houses and infrastructure:**

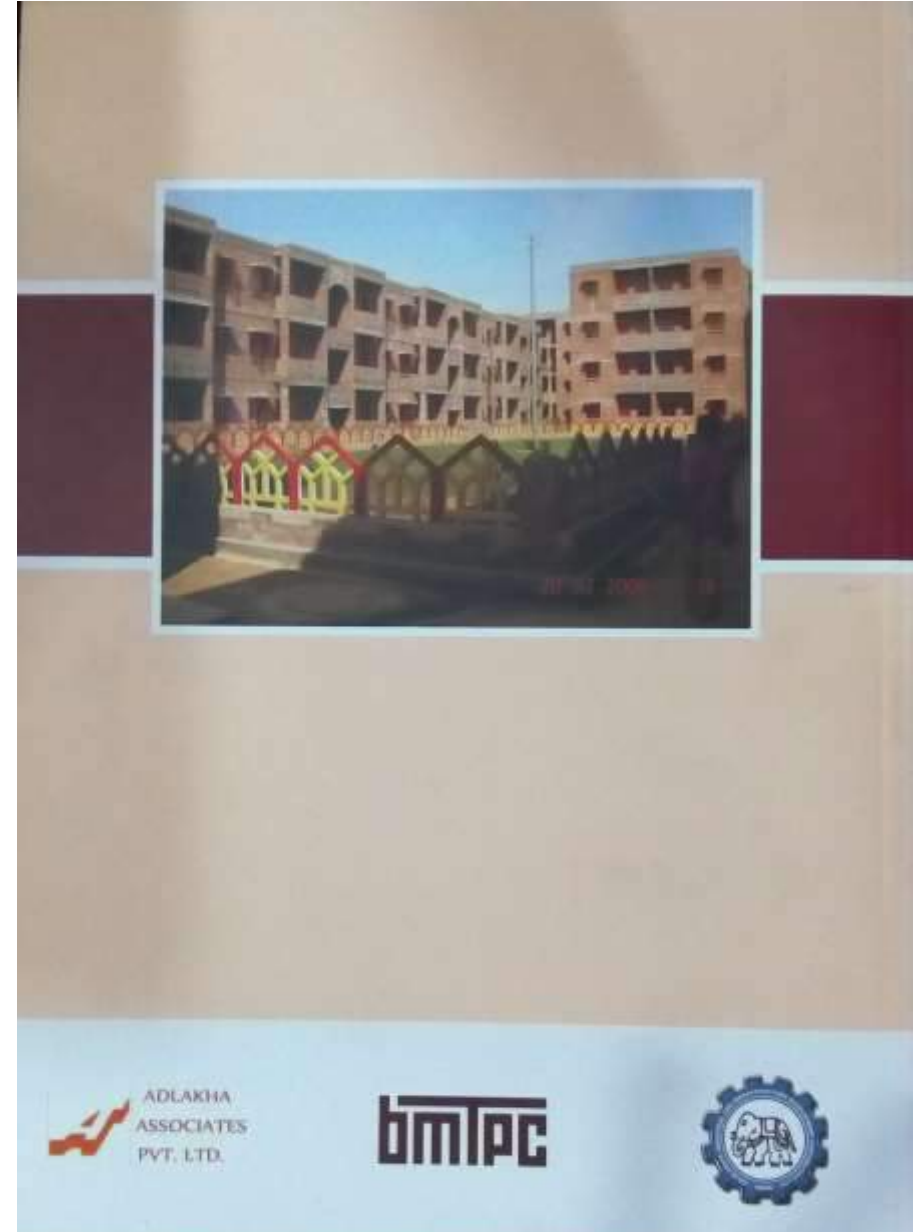
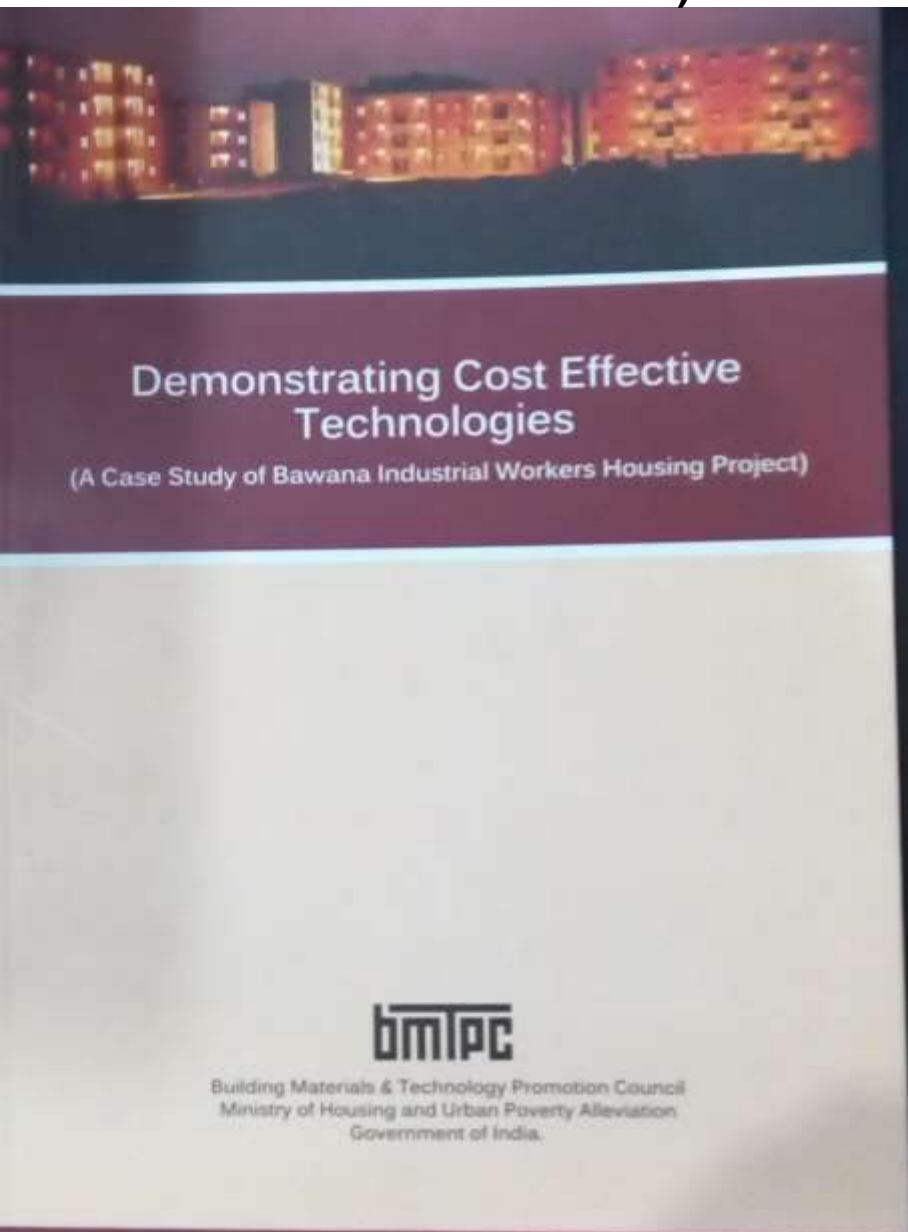
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**Buniyad Buland Bharat Buland**

Ministry of Housing & Urban Poverty Alleviation  
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[www.mhupa.gov.in](http://www.mhupa.gov.in)

# DEMONSTRATING COST EFFECTIVE TECHNOLOGIES (A CASE STUDY OF BAWANA INDUSTRIAL WORKERS HOUSING PROJECT)

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ADLAKHA ASSOCIATES PVT. LTD.





© 2010 Europa Technologies  
© 2010 Google  
Image © 2011 GooEye  
© 2010 Mapabc.com

© 2010 Google

Imagery Date: Jun 13, 2010

28°46'53.57" N 77°03'41.01" E elev 712 ft

Eye alt 2201 ft



- Layout Plan



- **Space Visualization**



Fig. 1 – Pile Casting through a  
Tremie



Fig. 2 – Reinforcement Cage in Under-ream Borehole



Fig. 3



Fig. 4

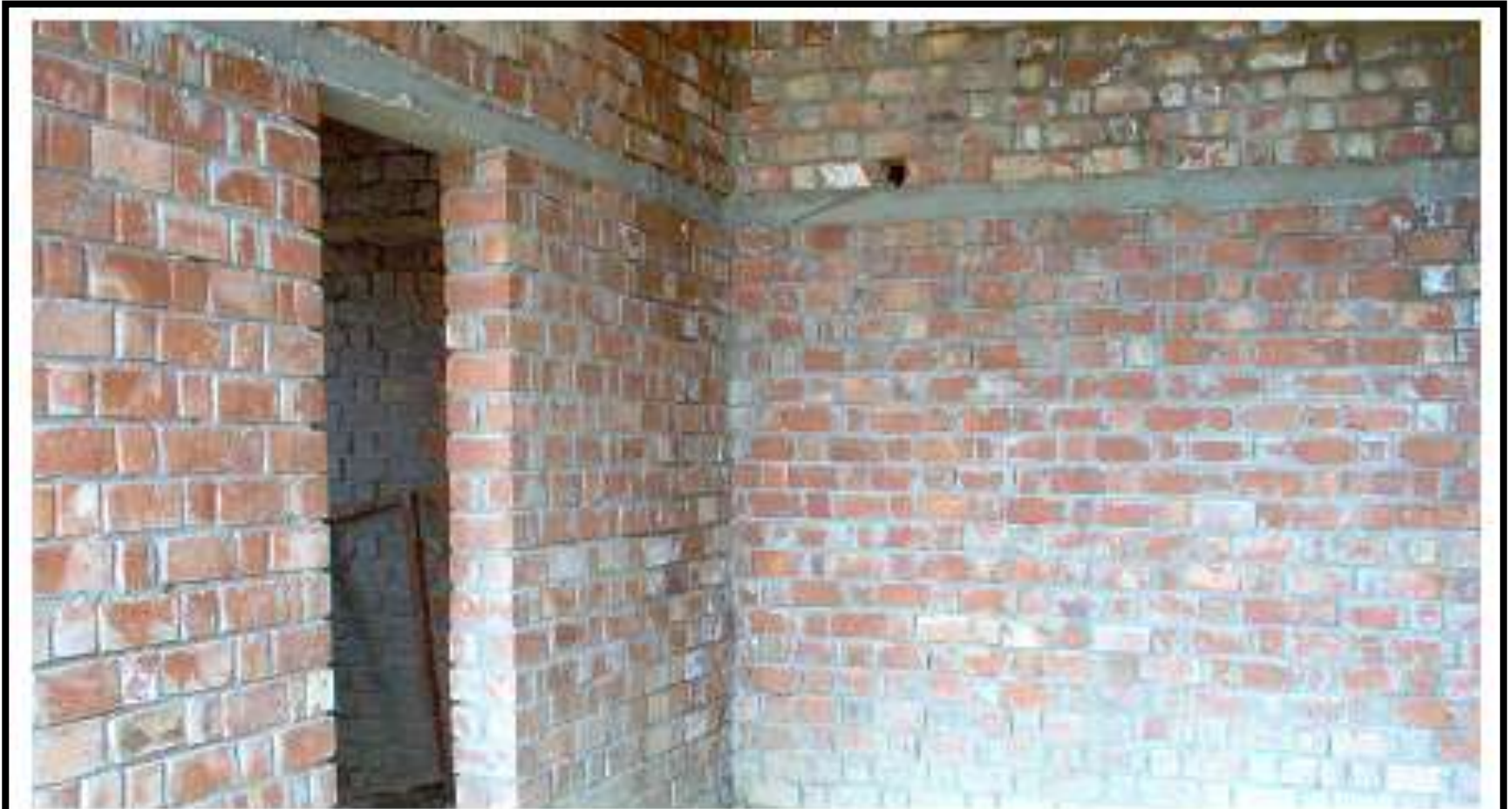
Casting of Under-reamed Piles in Progress



Grade Beam & Vertical Reinforcement (for Earthquake Resistance)



Plinth band & Vertical Reinforcement (for Earthquake Resistance)



Photograph of lintel band



Photograph of roof band

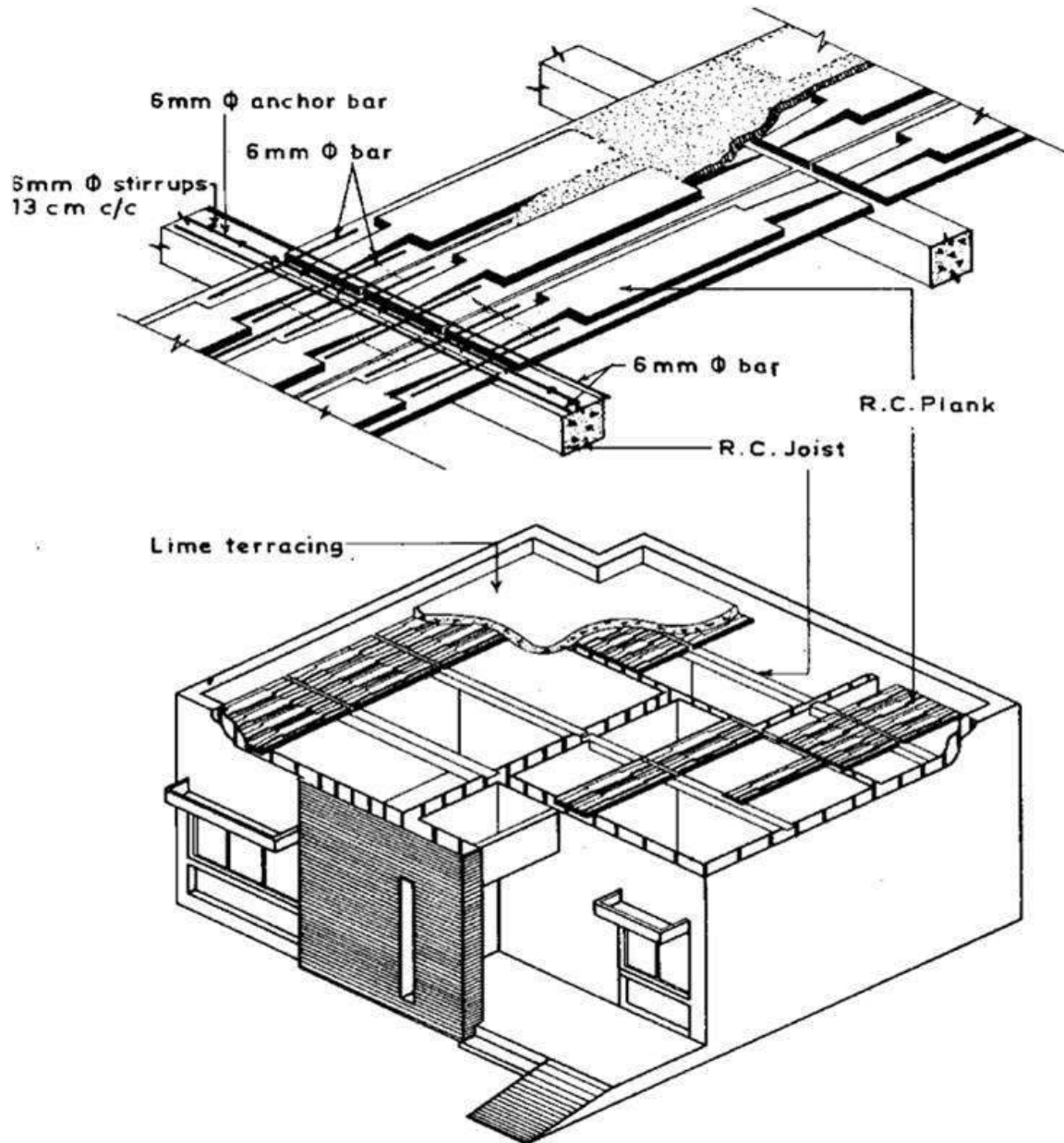


Vertical Reinforcement L - Junction



Vertical Reinforcement T - Junction

R . C . P L A N K S &  
J O I S T S



The plank and joist technology consists of 60mm thick specifically designed precast planks supported over precast joists.

Cast in situ concrete is poured over the slab forming a monolithic structure.

## Step 1: Preparation and collection of materials



## Step 1: Preparation and collection of materials



## Step 2: Preparing the machine for casting of planks



## Step 2: Preparing the machine for casting of planks



Setting up the trays with reinforcement mesh on plank machine

1  
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11  
12

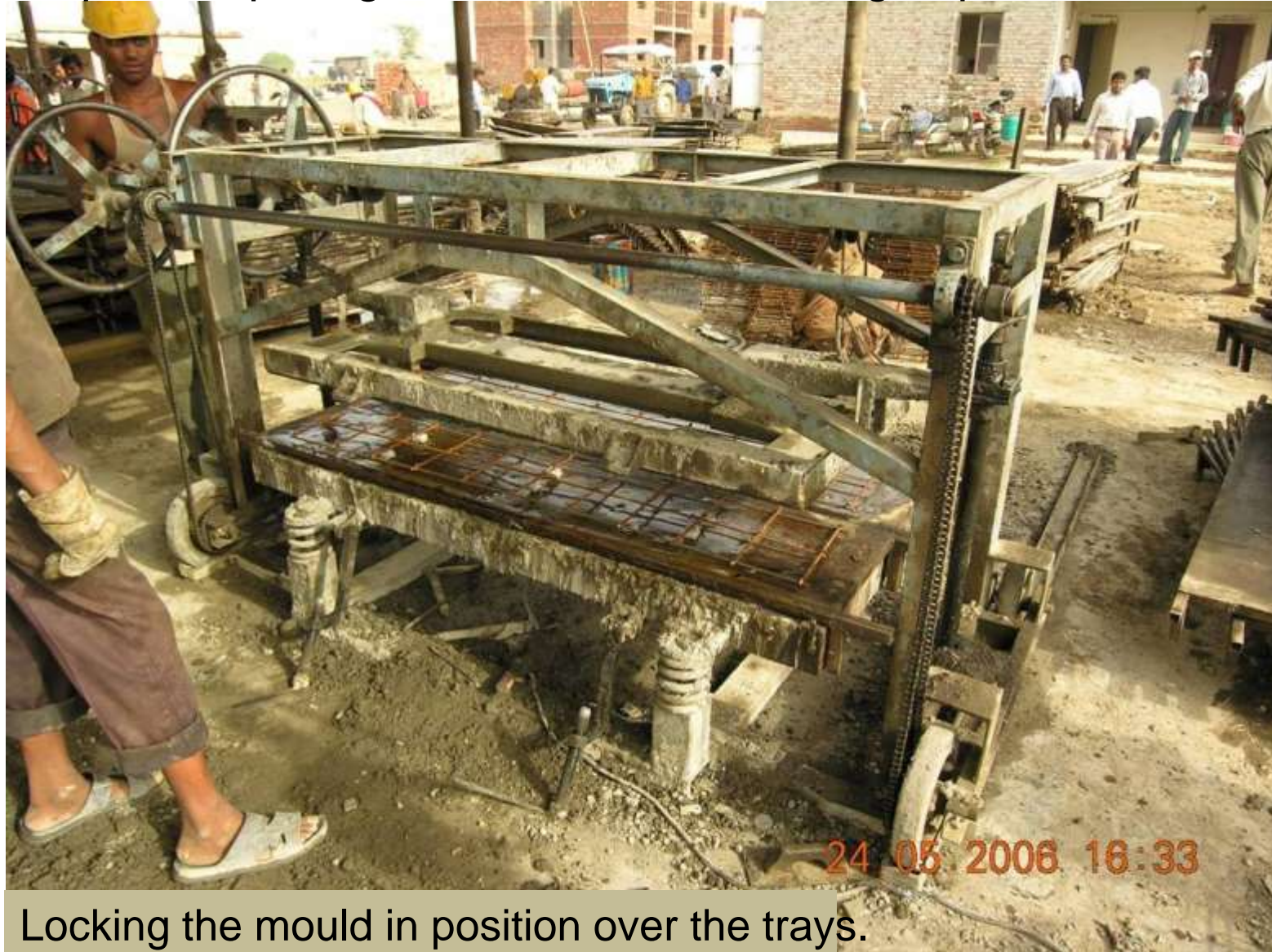
## Step 2: Preparing the machine for casting of planks



Setting up the trays with reinforcement mesh on plank machine

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## Step 2: Preparing the machine for casting of planks



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12

Locking the mould in position over the trays.

## Step 2: Preparing the machine for casting of planks



Locking the mould in position over the trays.

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12

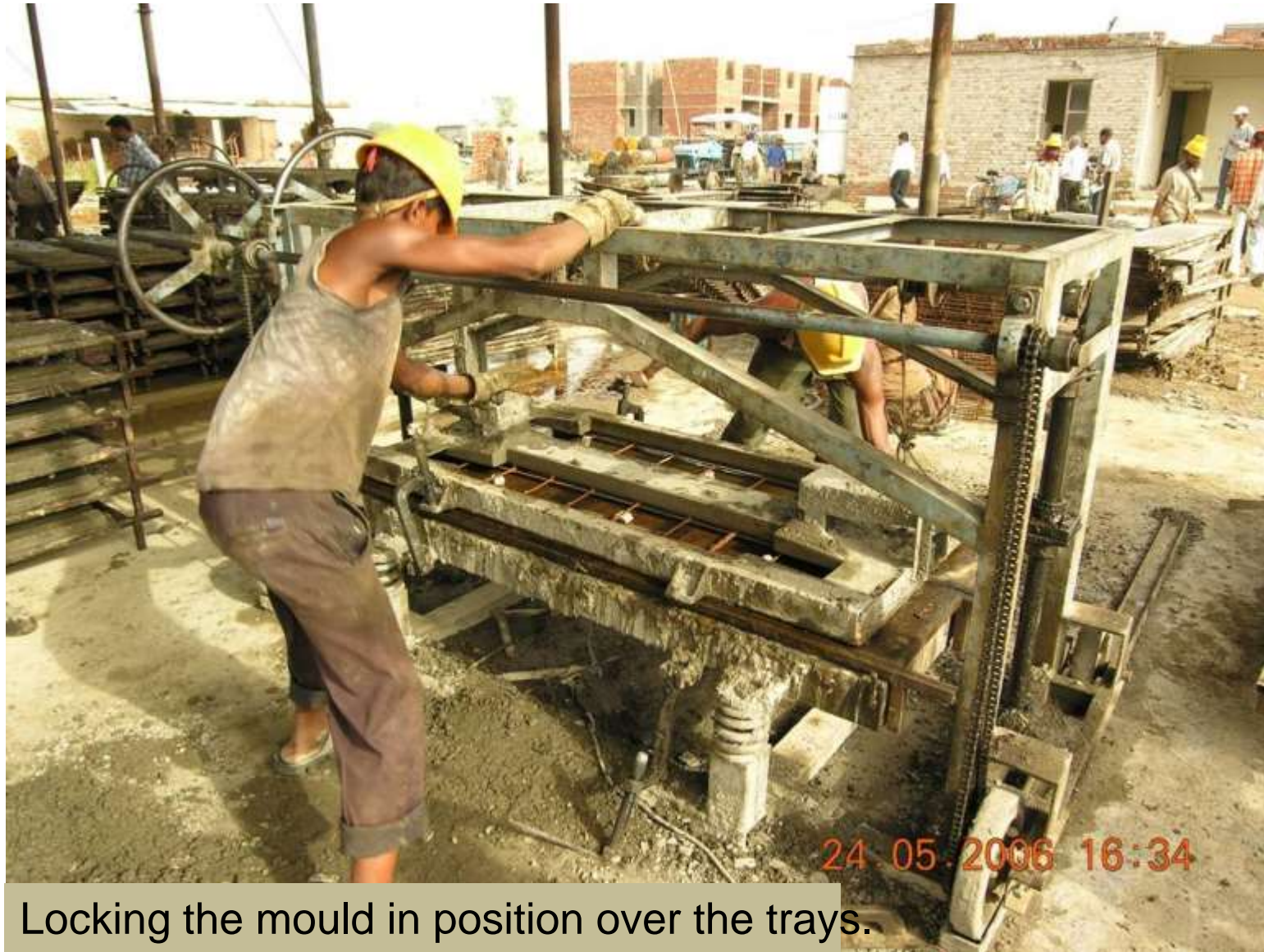
## Step 2: Preparing the machine for casting of planks



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9  
10  
11  
12

Locking the mould in position over the trays.

## Step 2: Preparing the machine for casting of planks



Locking the mould in position over the trays.

### Step 3: Casting of precast planks



Pouring in concrete over the mould.

1  
2  
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11  
12

### Step 3: Casting of precast planks



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12

Pouring in concrete over the mould.

### Step 3: Casting of precast planks



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Filling of concrete in the mould.

## Step 4: Process of disassembly of planks



## Step 4: Process of disassembly of planks



Unlocking the mould.

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12

## Step 4: Process of disassembly of planks



## Step 4: Process of disassembly of planks



## Step 5: Stacking and curing of planks



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9  
10  
11  
12

Stacked planks.

## Step 5: Stacking and curing of planks



23.09.2005 09:48

Curing complete. Stacking yard of planks.

1  
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11  
12

## Step 7: Casting of joists



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Mould preparation for joists using channels.

## Step 7: Casting of joists



Casting joists in moulds.

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## Step 8: Stacking and curing of joists



Curing of casted joists.

## Step 9: Placing joists on floor slab



Lifting joists to be taken to construction site.

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9  
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11  
12

## Step 9: Placing joists on floor slab



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Transporting joists to construction site.

## Step 9: Placing joists on floor slab



Transporting joists to construction site.

1  
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11  
12

## Step 9: Placing joists on floor slab



Transporting joists to construction site.

1  
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11  
12

## Step 10: Placing planks on the floor slab



Planks taken away from yard to the construction site.

## Step 10: Placing planks on the floor slab



Lifting and placement  
of planks on roof using a crane.

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12

Step 10: Placing planks on the floor slab



- 1
- 2
- 3
- 4
- 5
- 6
- 7
- 8
- 9
- 10**
- 11
- 12

Crane for lifting of planks.

## Step 11: Negative reinforcements over planks



## Step 11: Negative reinforcements over planks

1  
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7  
8  
9  
10  
**11**  
12



Negative reinforcements in haunches of planks.

## Step 12: Pouring cast in situ concrete



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11  
12

Pouring cast in situ concrete over planks.

## Step 12: Pouring cast in situ concrete



Leveling the cast in situ concrete.

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8  
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10  
11  
12

## Completed slab





VIEW OF CEILING.  
JOINTS ARE FINISHED WITH POINTING/POP.  
NO NEED FOR CEILING PLASTER.

# QUALITY ASSURANCE R.C PLANK LOAD TEST

PRAMOD ADLAKHA  
ADLAKHA ASSOCIATES PVT. LTD



R.C. PLANK LOAD TEST

QUALITY ASSURANCE  
R.C PLANK LOAD TEST

PRAMOD ADLAKHA  
ADLAKHA ASSOCIATES PVT. LTD



MOCK ASSEMBLY TEST

# FERRO-CEMENT



## HOW IS THIS TECHNOLOGY ENERGY EFFICIENT:

- Thin element, saves cement
- Saves shuttering
- Casted at site, no external transportation
- Less water consumption



# PRECAST FERRO-CEMENT

PRAMOD ADLAKHA  
ADLAKHA ASSOCIATES PVT. LTD

Precast  
Ferro-cement  
steps



# PRECAST FERRO-CEMENT

PRAMOD ADLAKHA  
ADLAKHA ASSOCIATES PVT. LTD



Precast  
Ferro-cement  
steps

# PRECAST FERRO-CEMENT

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Precast ferrocement sunshades



## Precast Ferro-cement



Precast ferro-cement Kitchen platform



Precast ferrocement water tank

- ✓ Reduction in consumption of
  - Bricks
  - Concrete
  - Cement
  - Sand
  - Steel reinforcement
- ✓ Elimination of ceiling plaster & external plaster
- ✓ Almost no shuttering/form work
- ✓ Reduction in internal wall plaster
- ✓ Perforated bricks/fly-ash bricks provide better insulation
- ✓ On site production – no outside transportation
- ✓ Low maintenance
- ✓ No heavy/large equipment required
- ✓ Less consumption means saving of embodied energy.

## Consumption of reinforcement steel

Cost effective housing: less than 1.0 kg per sq ft.

Conventional housing: 3 to 4 kg per sq ft.

STEEL  
Less than 1.0 kg per sq ft

## Consumption of cement

Cost effective housing: 0.25 BAGS per sq ft.

Conventional housing: 0.45 BAGS per sq ft.

CEMENT  
Less than 0.25 bags per sq ft

- Thus, savings in
- ✓ Resource Material
  - ✓ Embodied energy
  - ✓ CO<sub>2</sub>

*Case examples were taken of each housing block from 4 of our projects (ie. Bawana, Baprola, Bhorgarh and Narela) and estimates were prepared using one example of a conventional technology and one using precast systems.*

## WATER CONSERVATION

- ✓ During construction – due to less volume of masonry, concrete, no ceiling plaster, no external plaster.
- ✓ The precast slab panels, stairs, sunshades, shelves (thin elements) cured with spray of water.
- ✓ The mechanised bricks & high strength blocks, have high compressive strength and low water absorption.
- ✓ Ferrocement elements being thin elements – consume less water.
- ✓ Hardy plants species used which require less water (Acacia Arabica, Baryan, Pelpal, Ashok, Cedar etc)

# AFFORDABILITY IN TECHNOLOGY COMPARISON CHART – SAVINGS IN COST

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Item	Conventional	Alternative technology used	Advantages	Savings In Cost
Foundations	Isolated and step footings	Under-reamed piles In load bearing Structure	Economical as well as speedy construction	10%
Walls	230 mm Brick wall in English bond (using conventional FPS, Clay Bricks)	200 mm thick brick wall in Flemish bond (using machine made modular perforated bricks)	<ul style="list-style-type: none"> <li>Reduction in wall thickness due to high strength bricks</li> <li>No plaster on external faces</li> <li>Heat &amp; Sound resistance</li> </ul>	20%
Intermediate floors & roof	Cast-in-situ RCC slab	Precast RC Plank system	<ul style="list-style-type: none"> <li>Saving in cement, Steel &amp; shuttering</li> </ul>	21%
Stair case	Cast-in-situ RCC joist slab	Precast ferrocement steps 25 mm thick (tread & riser unit)	<ul style="list-style-type: none"> <li>Cost effective (no Plaster required)</li> </ul>	30%
Sunshades Cum Lintels	Cast-in-situ RCC slab	Precast RC	<ul style="list-style-type: none"> <li>Controlled conditions</li> </ul>	25%
Kitchen Platforms	Cast-in-situ RCC slab	Precast ferrocement 25 mm thick	<ul style="list-style-type: none"> <li>Speedy construction</li> <li>Better finishes &amp; Aesthetics</li> </ul>	30%
Water Tanks	RCC, PVC	Ferrocement		20%

## Table 3: Perceived Indoor Environmental Conditions

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Cross tabulation of householder responses on perception of indoor temperature, air quality and air movement with their corresponding response for overall experience **DURING SUMMER**

Perceived indoor temperature in summer	Unsatisfactory	Bearable	Satisfactory	Row total
Unsatisfactory	45	11	0	56
Bearable	4	64	5	73
Satisfactory	0	6	13	19
Column total	49	81	18	148
Perceived indoor air quality in summer				
Stuffy	43	24	1	68
Bearable	6	54	13	73
Fresh	0	3	4	7
Column total	49	81	18	148
Perceived indoor air movement in summer				
Draughty dw (door & window)	1	1	0	2
Still	24	31	4	59
Well-ventilated	24	49	14	87
Column total	49	81	18	148

# Table 4: Perceived Indoor Environmental Conditions

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Cross tabulation of householders' responses for their perception of indoor temperature, air quality and air movement with their corresponding response for overall experience **DURING WINTER**

Perceived indoor temperature in winter	Unsatisfactory	Bearable	Satisfactory	Row total
Unsatisfactory	12	7	1	20
Bearable	4	85	5	94
Satisfactory	0	8	24	32
Column total	16	100	30	146
Perceived indoor air quality in winter				
Stuffy	9	15	1	25
Bearable	6	84	22	112
Fresh	1	1	7	9
Column total	16	100	30	146
Perceived indoor air movement in Winter				
Draughty dw (door & window)	6	24	0	30
Still	6	43	10	59
Well-ventilated	4	33	20	57

# **MORTAR-LESS INTERLOCKING BLOCK TECHNOLOGY**

**Project: InnoGeocity  
Oragadam, Chennai**

**Project: Staff Workers housing  
Anjar & Vapi, Gujrat**

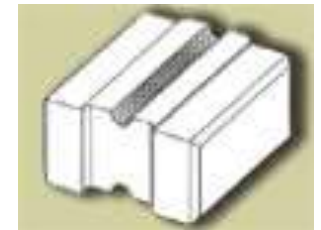
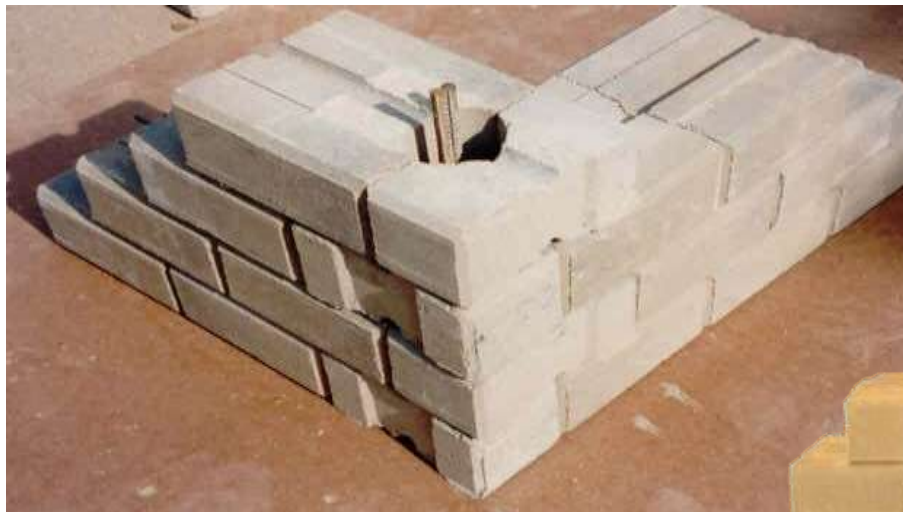
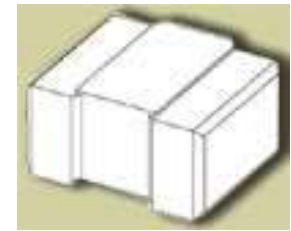
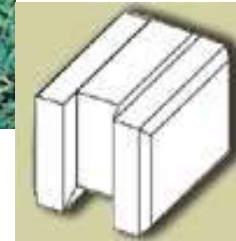
**Project: Ministry of Animal Husbandry  
Balabgarh, Faridabad**

# INTERLOCKING BLOCKS

## INTERLOCKING CONSTRUCTION

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- An alternate to conventional bricks & mortar
- Male/Female Interlocking – Vertical / Horizontal Shear keys
- Suitable for Load/Framed Structures Compatible to incorporate V/H reinforcements
- Suitable for Seismic structures
- Speedier construction



# INTERLOCKING BLOCKS

## INTERLOCKING CONSTRUCTION

PRAMOD ADLAKHA  
ADLAKHA ASSOCIATES PVT. LTD

### HOW IS THIS TECHNOLOGY ENERGY EFFICIENT:

- Locally available resources used
  - Fly-Ash
- No burning – eco friendly
- No transportation – can be casted at site.

- Low embodied energy – minimal cement.
- No plaster - hence reduction in cement and CO2
- Reusable and recyclable blocks
- Thermally efficient
- Fast construction











**DOOR FRAMES & STAIRCASE**

## Actual Completed Building Photographs



**HYDRAFORM INTERLOCKING BLOCKS**



**Project: InnoGeocity (Phase 1)  
500 houses in Oragadam, Chennai, India**

**Owners: Inno Group Holdings  
Architecture consultants:  
Adlakha Associates Pvt. Ltd., India**

## Actual Completed Building Photographs



**HYDRAFORM INTERLOCKING BLOCKS**

**Project: Staff Workers housing  
Anjar & Vapi, Gujrat, India  
(Technology used in Zone V earthquake zone)**



**Owner: M/S Welspun Group, India  
Architecture consultants:  
Adlakha Associates Pvt. Ltd., India**

## Actual Completed Building Photographs



**HYDRAFORM INTERLOCKING BLOCKS**

**Project: Ministry of Animal Husbandry,  
Balabgarh, Faridabad, India**

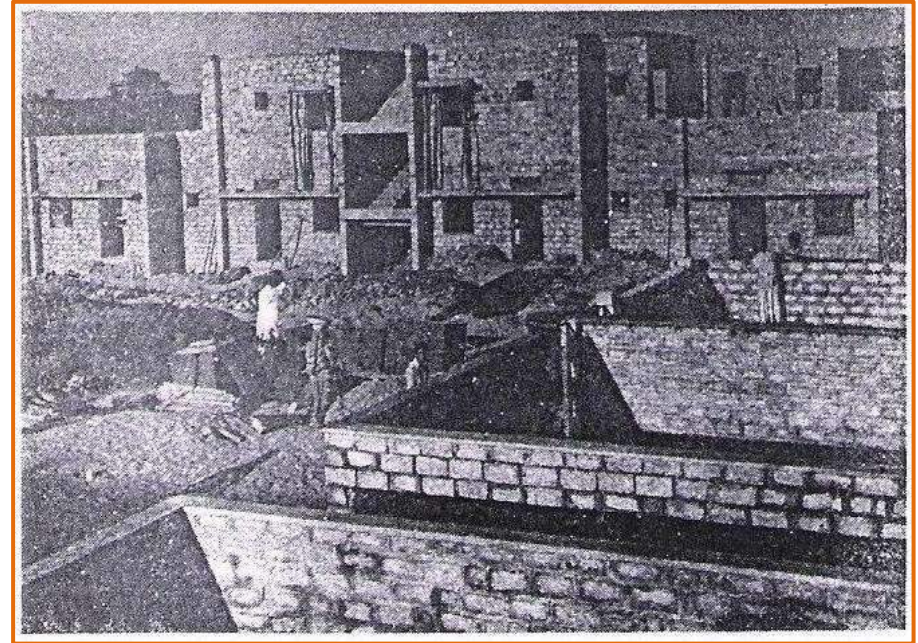


**Architecture consultants:  
Adlaka Associates Pvt. Ltd., India**

# PRECAST STONE BLOCK MASONRY

**Project: Staff Workers housing  
Anjar & Vapi, Gujrat**

**Project: Staff housing, Bhopal**



**A Building in Housing Rajasthan With Stone Block Masonry**



**View of stone block masonry housing at Bhopal**



**Foundation at Vapi site with Concrete Blocks**

# CASE STUDY VERNACULAR TECHNOLOGIES

POETRY IN BRICKS,  
Manesar



ART

ARCHITECTURE

ENGINEERING

POETRY IN BRICKS



Image © 2014 CNES / Astrium

Google earth

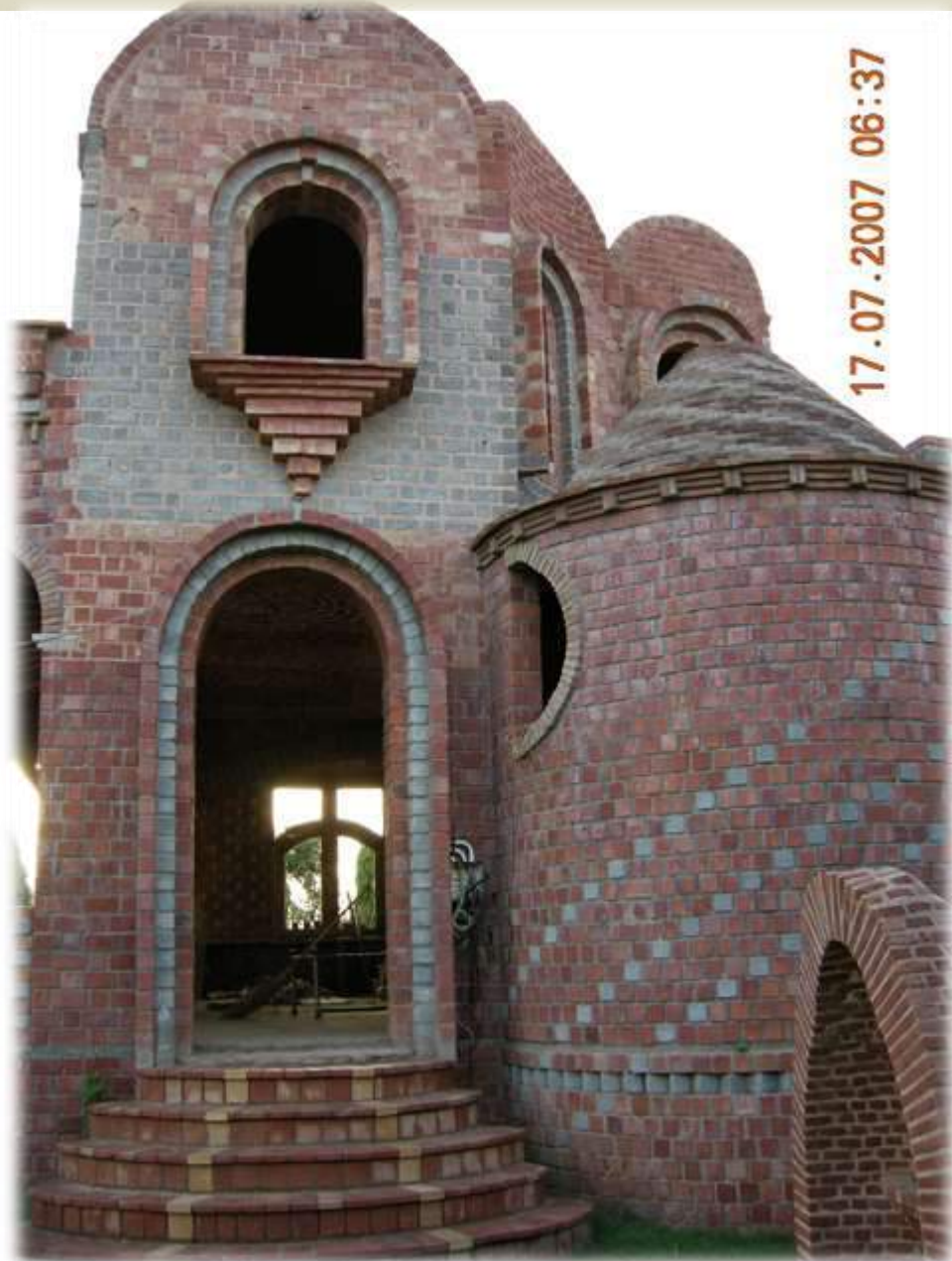
# THE BUILT FORM

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# THE BUILT FORM

PRAMOD ADLAKHA  
ADLAKHA ASSOCIATES PVT. LTD



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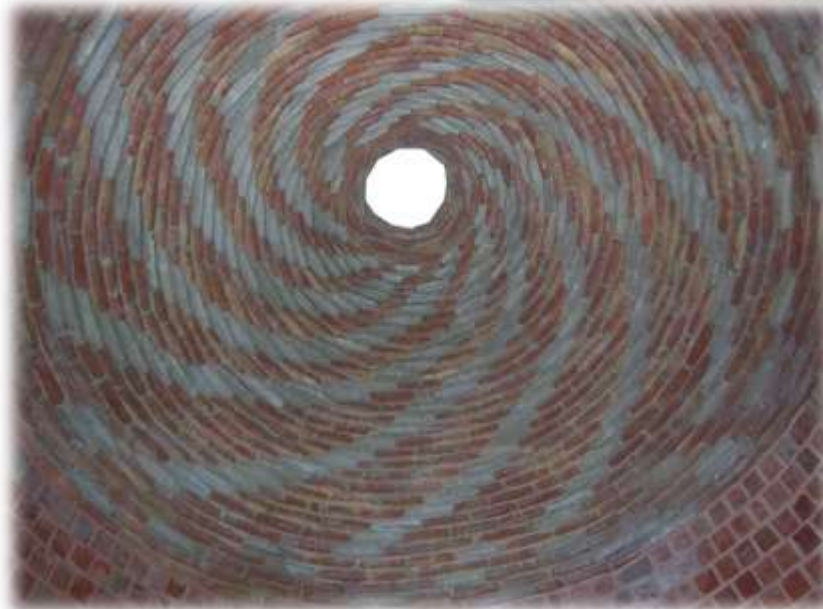
# THE BUILT FORM

PRAMOD ADLAKHA  
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# INTERNAL VIEWS - CEILING

PRAMOD ADLAKHA  
ADLAKHA ASSOCIATES PVT. LTD



# INTERNAL VIEWS - CEILING

PRAMOD ADLAKHA  
ADLAKHA ASSOCIATES PVT. LTD



# INTERNAL VIEWS – FIRE PLACE

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# INTERNAL VIEWS – ROOMS

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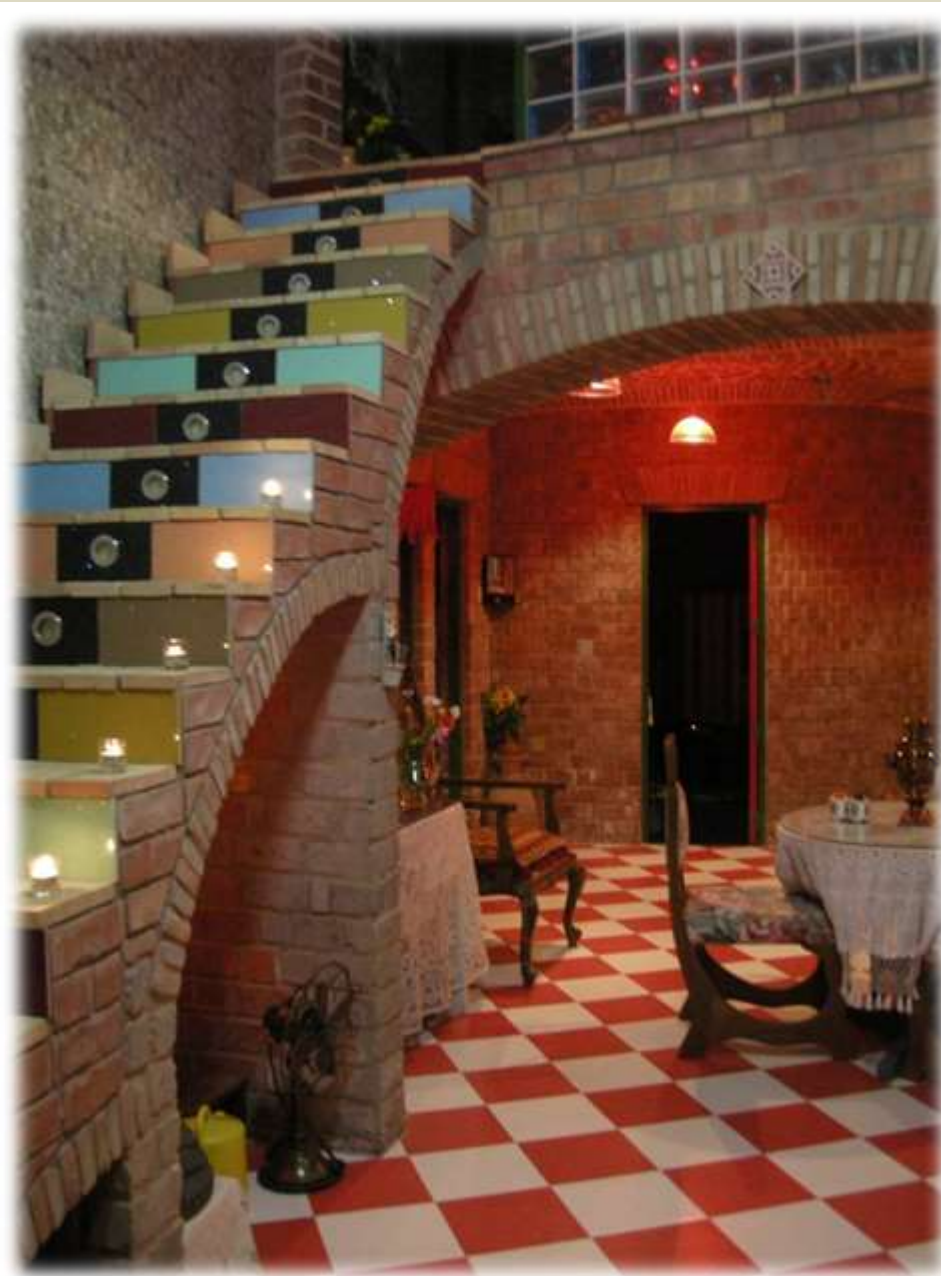
# INTERNAL VIEWS – ROOMS

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# FEATURED ELEMENT - STAIRCASE

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# FEATURED ELEMENT - STEPS

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# THE DRIVEWAY & ENTRANCE

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# KITCHEN AND GARDEN

LTD



# MORE PATTERNS IN BRICK

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# MORE PATTERNS IN BRICK

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# NIGHT VIEWS - interior

PRAMOD ADLAKHA  
ADLAKHA ASSOCIATES PVT. LTD



# NIGHT VIEWS - interior

PRAMOD ADLAKHA  
ADLAKHA ASSOCIATES PVT. LTD



# NIGHT VIEWS - interior

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ADLAKHA ASSOCIATES PVT. LTD



# NIGHT VIEWS - interior

PRAMOD ADLAKHA  
ADLAKHA ASSOCIATES PVT. LTD



# NIGHT VIEWS - outside

PRAMOD ADLAKHA  
ADLAKHA ASSOCIATES PVT. LTD



# NIGHT VIEWS - outside

PRAMOD ADLAKHA  
ADLAKHA ASSOCIATES PVT. LTD

